ICHIPA Support Data Extension
for the
National Imagery Transmission Format

1.0 Introduction

As mensuration and geopositional tools proliferate within the United States Imagery and Geospatial Information System (USIGS) environment and the use of NITF image chips continues to expand, potential problems have been identified by the NITF Technical Board (NTB). One such problem arises when a mensuration tool, such as RULER, is applied to an NITF image chip to determine the length or geoposition of an object within that chip. RULER requires, as input, data that references the original full image as well as the image chip. This information is not provided within the NITF 2.0 header/subheader fields, or within the NITF Support Data Extension (SDE) fields. This has resulted in the implementation of various, non-standard solutions for transferring this much needed “chipping” data along with an NITF chip. The proposed ICHIPA SDE is an attempt to standardize the solution so that any recipient of an image, regardless of system or application, will be able to access the necessary data and apply RULER to the image chip in a uniform and consistent manner.

1.1 Purpose of this Document

This paper provides a background of the circumstances leading up to the requirement for ICHIPA and provides guidance to users on how this tag may be used. One of this paper’s goals is to support consistent community implementation of ICHIPA.

2.0 ICHIPA Overview

As mensuration and geopositioning tools proliferate, several issues have been identified concerning the application of these tools to NITF-formatted image chips. Specifically, there is no mechanism, in the current NITF format, to pass a standardized set of data with an image chip such that a user can easily apply RULER to that image. In order to apply Ruler to an NITF image, the user must proivde the RULER application with the four corner points of the original full image as well as the offsets to the image chip. Unless this information is precisely included with the image chip, a user must use alternate methods to generate this data. As a result, several system-specific solutions have been proposed and implemented within the community. Each of these solutions addresses the problem in a different manner, and in many instances, do not generate the same exact corner points or offsets. In addition, the accuracies of these line and sample points vary. These factors could lead to a scenario where three imagery exploitation systems receive identical images, apply their unique algorithm, derive the corner points and chip offsets from the full image, input the data to RULER, and receive mensuration results that are not identical.

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An NITF Controlled tag can easily prevent this solution. By standardizing the data elements (which includes the line and sample corner points, offset data, etc. in a consistent manner) within this tag, and including it with all image chips, exploiters will be more likely to arrive at the same answer from the mensuration process.

Another typical scenario involves the “chip of a chip” scenario. An exploiter in the Washington DC area satisfies an exploitation request and generates an exploited image chip. This image chip is disseminated as an NITF Product to a single user and is also archived in an Image Product Library (IPL). Another user at CENTCOMM downloads the image from the IPL and proceeds to mensurate on the image using RULER. Unless ICHIPA is included with the image, he/she can not be sure that the results from RULER are based on valid inputs. This user then takes a subset of the image and generates a chip from the chip, which is then forwarded to a tactical user. The tactical system receiving the second generation chip wants to apply a geopositioning tool to the image, but will be unable to unless he/she has a specific, standard way to reference the original full image line and sample corner points. ICHIPA again is the best solution to satisfy the mensuration processn.

2.1 Background

This proposal for ICHIPA was developed via a series of technical interchange meetings as well as through comments and inputs from the NTB community. The proposed ICHIPA tag was based on the simplification and generalization of the currently registered I2MAPD tag. System specific I2MAPD data fields were either removed or generalized such that there would be no system dependencies within ICHIPA.

3.0 Implementation of ICHIPA

ICHIPA is a system-independent NITF SDE that, when included with all NITF image chips, will support all users within the USIGS environment for the mensuration of image chips. It holds the support data that analysts need when using RULER to mensurate or determine detailed geospatial parameters on pixel based features within image chips. ICHIPA also holds other limited processing related information, such as various correction indicators and scale factor, that are useful to receiving systems.

It is recommended that the ICHIPA controlled tag be generated by all NITF systems that generate NITF formatted image chips which include the RULER data extensions, and sent electronically to other NITF users. NITF receiving systems will be expected to read and interpret the information within ICHIPA if they have requirements to mensurate on the received image chip. It is expected that the ICHIPA extension will be populated in addition to the normal complement of SDE extensions.

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RULER mensuration uses the line and sample indexing scheme of the original image to determine various geospatial measurements and position within an image, be it the original image or a chip of the original image. ICHIPA captures image chip corner point coordinate information that is mapped to the original image coordinate system as shown in figure 3-1. The mapping function is the result of a linear interpretation between image corner points and as such, can be assumed for only the simple linear (nondewarped) processed imagery.

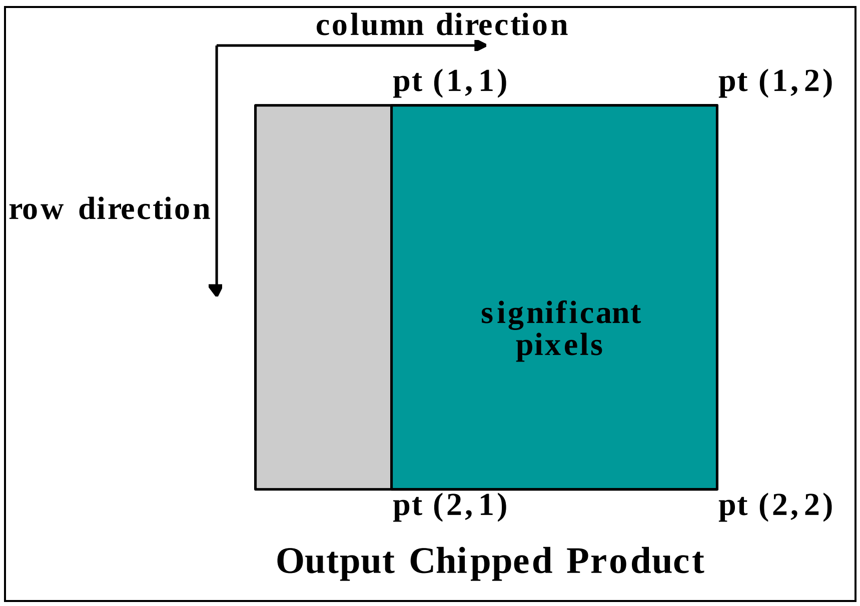

FIGURE 3-1

The reason for this is twofold. First, few systems today process non-dewarped imagery and even fewer can mensurate and calculate geopositions from dewarped imagery. Second, due to the complexity of the algorithms that derive line and sample corner points and offset data, as well as the required processing power required, standardization of the algorithms for the community would be difficult. Therefore, standardizing the linear transformation, a straight forward process, is an appropriate baseline for ICHIPA.

In addition, a new tag or a revision to ICHIPA is recommended for more complex mensuration requirements. This is because the current tag is not sufficient for addressing dewarp scenarios.

To maintain interoperability within the USIGS, ICHIPA should be included with all non-dewarped NITF chips, specifically when the chip is disseminated. It is recommended that it not be included with dewarped images.

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3.1 Format

The ICHIPA controlled tag provides the data needed to mensurate and calculate geopositions of features on chips. This tag provides the output product row and column data for the image, as well as those data points referenced back to values for the original full image. For this tag, the original line and sample will be provided at the four corners of the significant image data.

Version 1.0 of ICHIPA represents a major simplification of I2MAPD pertaining to dewarped (non-linear) capabilities. For example, the previously existing grid overlay has been deleted. As such, ICHIPA deals only with linear situations where only the four line and sample “original” product coordinates are considered. Thus, there is no need for nth order polynomials and the tag length is fixed at 208 bytes. On the other hand, several existing features have been retained such as the non-linear transformation flag, which indicates whether the associated image is dewarped or not, and the anamorphic correction indicator. The scan block number is added to reflect comments received from the user community.

The tagged record fields for the ICHIPA extension are specified in Tables 1, 2 and 3.

Table 1 - ICHIPA tagged record sub-header fields

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique extension type identifier	6	ICHIPA	R
CEL	Length of CEDATA field	5	00208	R
CEDATA	User-defined data	208	See Table 2	R

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Table 2 - ICHIPA User Defined field format

FIELD	NAME	SIZE	VALUE RANGE	TYPE
XFRM_ FLAG	Non-linear Transformation Flag	2	Numeric 00 (nondewarped, data provided), 01 (no data provided)	R
SCALE_ FACTOR	Scale Factor Relative to R0 (original full image resolution)	10	Numeric (typically reciprocal of display magnification) xxxx.xxxxx	R
ANAMRPH _CORR	Anamorphic Correction Indicator	2	Numeric (00 or 01)	R
SCANBLK_ NUM	Scan Block Number (scan block index)	2	00-99 00 if not applicable	R
OP_ ROW_11	Output product row number component of grid point index (1,1) for significant data	12	Numeric xxxxxxxx.yyy (typically 00000000.500)	R
OP_ COL_11	Output product column number component of grid point index (1,1) for significant data	12	Numeric xxxxxxxx.yyy (typically 00000000.500)	R
OP_ ROW_12	Output product row number component of grid point index (1,2) for significant data	12	Numeric xxxxxxxx.yyy	R
OP_ COL_12	Output product column number component of grid point index (1,2) for significant data	12	Numeric xxxxxxxx.yyy	R
OP_ ROW_21	Output product row number component of grid point index (2,1) for significant data	12	Numeric xxxxxxxx.yyy	R
OP_ COL_21	Output product column number component of grid point index (2,1) for significant data	12	Numeric xxxxxxxx.yyy	R

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OP_ ROW_22	Output product row number component of grid point index (2,2) for significant data	12	Numeric xxxxxxxx.yyy	R
OP_ COL_22	Output product column number component of grid point index (2,2) for significant data	12	Numeric xxxxxxxx.yyy	R
FI_ ROW_11	Grid point (1,1), row number in full image coordinate system	12	Numeric xxxxxxxx.yyy	R
FI_ COL_11	Grid point (1,1), column number in full image coordinate system	12	Numeric xxxxxxxx.yyy	R
FI_ ROW_12	Grid point(1,2), row number in full image coordinate system	12	Numeric xxxxxxxx.yyy	R
FI_ COL_12	Grid point(1,2), column number in full image coordinate system	12	Numeric xxxxxxxx.yyy	R
FI_ ROW_21	Grid point (2,1), row number in full image coordinate system	12	Numeric xxxxxxxx.yyy	R
FI_ COL_21	Grid point (2,1), column number in full image coordinate system	12	Numeric xxxxxxxx.yyy	R
FI_ ROW_22	Grid point (2,2), row number in full image coordinate system	12	Numeric xxxxxxxx.yyy	R
FI_ COL_22	Grid point (2,2), column number in full image coordinate system	12	Numeric xxxxxxxx.yyy	R

Note:

- Row and column indexing, NITF nomenclature, corresponds to line and sample indexing in original product nomenclature.

- If XFRM_FLAG is 01, then remaining values will be zero fill.

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Table 3 - ICHIPA User Defined field definitions

FIELD	VALUE DEFINITIONS AND CONSTRAINTS
XFRM_FLAG	Non-linear Transformation Flag. If image is nondewarped, field is 00. For all others, flag is 01 with zero fill in the remaining fields.
SCALE_FACTOR	Scale factor relative to the full image resolution R0. This provides a mechanism to reference back to the full image if product is not at R0. To determine product RRDS value: if 0001.00000 then 00; 0002.00000 then 01; 0004.00000 then 02; 0008.00000 then 03; 0016.00000 then 04; 0032.00000 then 05; 0064.00000 then 06; 0128.00000 then 07
ANAMRPH_CORR	If no anamorphic correction, 00; otherwise 01
SCANBLK_NUM	Scan block number from which the product was chipped if applicable; otherwise 00
OP_ROW_11	Output product row number component of grid point index (1,1) for significant data. Typically 00000000.500
OP_COL_11	Output product column number component of grid point index (1,1) for significant data. Typically 00000000.500
OP_ROW_12	Output product row number component of grid point index (1,2) for significant data.
OP_COL_12	Output product column number component of grid point index (1,2) for significant data.
OP_ROW_21	Output product row number component of grid point index (2,1) for significant data.
OP_COL_21	Output product column number component of grid point index (2,1) for significant data.
OP_ROW_22	Output product row number component of grid point index (2,2) for significant data.
OP_COL_22	Output product column number component of grid point index (2,2) for significant data.
FI_ROW_11	Grid point (1,1), row number in full image coordinate system.
FI_COL_11	Grid point (1,1), column number in full image coordinate system.
FI_ROW_12	Grid point (1,2), row number in full image coordinate system.
FI_COL_12	Grid point (1,2), column number in full image coordinate system.
FI_ROW_21	Grid point (2,1), row number in full image coordinate system.
FI_COL_21	Grid point (2,1), column number in full image coordinate system.
FI_ROW_22	Grid point (2,2), row number in full image coordinate system.
FI_COL_22	Grid point (2,2), column number in full image coordinate system.

3.2 Effectivity

This ICHIPA proposal impacts the imagery and mapping community from both the system development and CONOPS perspectives within the USIGS. As a result, to provide adequate time for program offices and systems/software developers to assess impacts and plan implementations, ICHIPA's effectivity will be tied to the effectivity for NITF 2.1, currently defined as October, 1998.

4.0 Testing and Validation Methodology

As changes or additions are nominated to the NITF standard, they must be validated through testing prior to ISMC approval for implementation and addition to the certification requirements of the NITFS certification test program. Validation testing ensures that the changes or additions to be included in the NITF Standard are technically correct, consistent, complete, and testable.

The process for validating a proposed standard or proposed change or addition to an existing standard is as follows:

Step 1. The service, functional, and/or performance requirements are fully identified and an appropriate authority ratifies that the requirements are valid. The test objectives and criteria are developed that will be used to ascertain whether the proposed solution satisfies the validated requirements.

Step 2. As the proposed standard is being written, compliance test objectives, criteria, and test cases are also written.

Step 3. A physical realization of the proposed standard must be implemented. The test procedures and tools needed to conduct compliance testing must also be developed independently of the developer, but in synchronization with the development of the sample implementation.

Step 4. The compliance test procedures and tools are used to verify that the sample implementation conforms to the proposed written standard. Based on compliance test results, the sample implementation is modified and re-tested until it adequately conforms with the proposed standard.

Step 5. Once the sample implementation has been verified as compliant to the proposed standard, the implementation is evaluated against the objectives and criteria defined in Step 1 to measure how well the proposed standard meets the original service, functional, and/or performance requirements. Upon successful completion of this step, the standard is considered to be validated. A natural outcome of the validation process is the creation of the Means of Testing (MOT), e.g. test procedures and tools, for testing products for compliance with the standard.

5.0 Summary

The ICHIPA NITF SDE is proposed as a mechanism by which exploiters of non-dewarped imagery chips can generate the required data for Ruler mensuration. By requiring that all systems generating non-dewarped imagery implement this tag, interoperability will be maintained. This standard will enforce a uniform solution to the application of Ruler to NITF images. The effectivity of 1 Oct 1998 will provide sufficient time for commercial and government developers to plan for the use of ICHIPA within their systems, tools, and products.

6.0 Glossary

Chip	A portion of another image, be it the original image as captured by a sensor, or a sub-image cropped from an original; it can be an unexploited image or an or
Geopositioning	The process of determining the precise location of an object relative to the Earth’s surface.
Line and Sample	The row and column of the image, respectively
Mensuration	The process of measuring distances and objects (length, width, volume) on an image or map